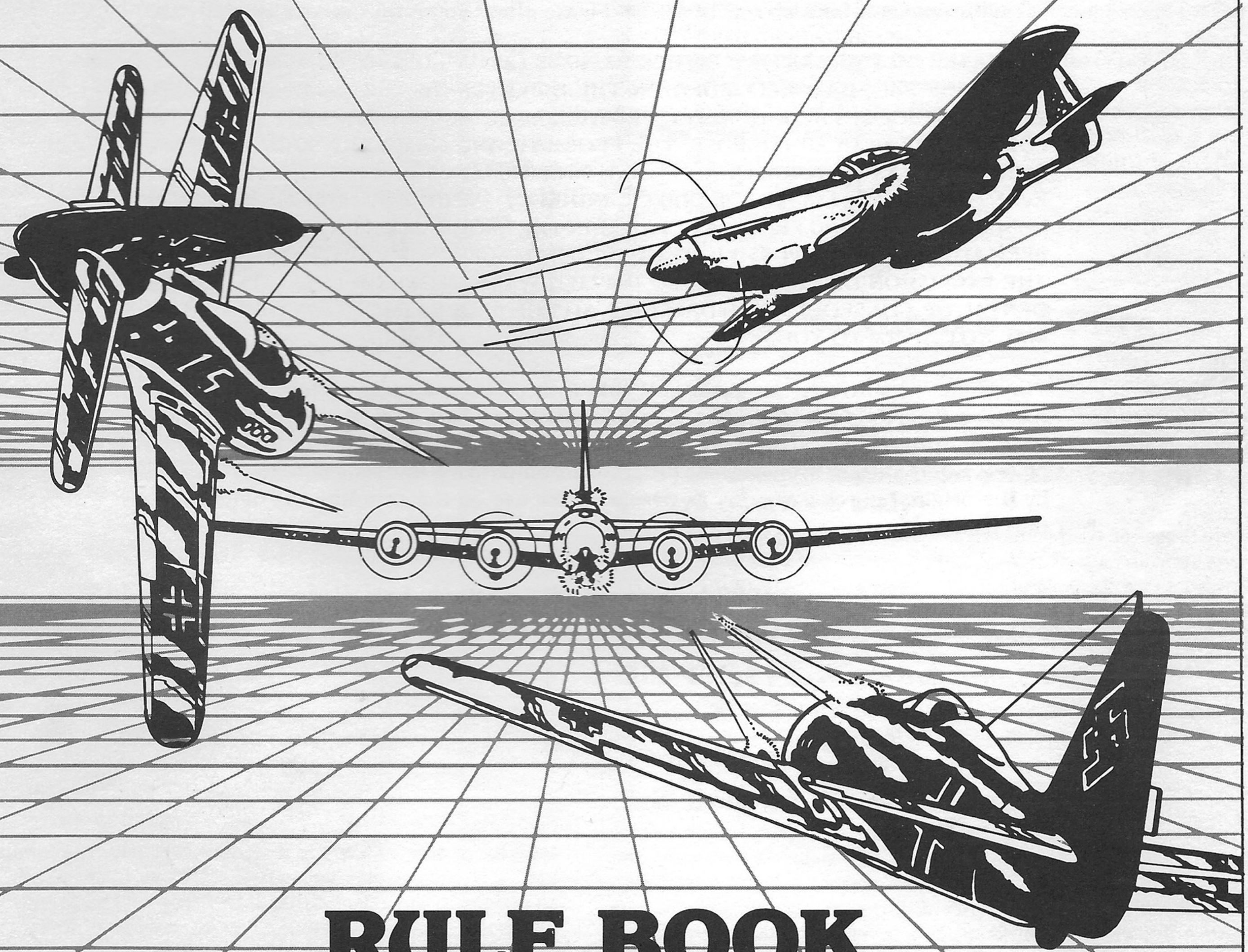
# COMPUTER AIR COMBAT™



## RULE BOOK & Historical Background

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**If you are using DOS 3.3, you must use a 13-sector scratch disk when saving data files. This disk must be initialized prior to use.**

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# 1.0 Introduction

Computer Air Combat is a simulation of aerial warfare during World War II. Players have the option of flying American, British, German or Japanese aircraft in a variety of different air combat missions. Each of the different aircraft types will maneuver, attack and absorb damage in the game according to how it actually performed in combat. These rules are intended to introduce you to basic concepts necessary to play the game. They do not provide details of the extensive mathematical formulas and data used to simulate aircraft performance or determine the outcome of attacks. These details are left for each player to discover as he plays the game, just as a new fighter pilot often had to "learn the hard way" by climbing into the cockpit and taking off to engage the enemy. If you are playing this game for the first time, it is recommended that you read the rules up through section 8, then play along with the instructional flight example presented in section 9. After that, you're ready to solo!

# 2.0 General Description

## 2.1 Parts Inventory

A. Game Box
B. Rule Book
C. 5¼" Game Disc
D. Two Mapboard Cards
E. Two Aircraft Data Cards
F. Game Selection Card
G. Two Grease Pencils

## 2.2 Game Units

Horizontal distances and altitudes are measured in kilofeet (1000 feet, abbreviated kft). Distances are displayed to the nearest tenth of a kilofoot (100 feet); altitudes are displayed to the nearest hundredth of a kilofoot (10 feet). Speed is displayed in miles per hour (mph), rounded to the nearest 10 mph. Each game turn represents approximately seven seconds of real time. The precise value was selected so that in one turn the distance moved in kilofeet is equal to speed in miles per hour divided by 100. For example, an aircraft traveling 250 mph will move 2.5 kft per turn.

## 2.3 Passwords

At the start of each two-player game both players will be required to enter a password of one to five characters. It is important that each player keep his password to himself. This will ensure that secret information held by the computer is revealed only to the appropriate player.

## 2.4 Saving a Game

A game in progress may be saved at the start of any move or combat phase for either player. Saving a game allows you to resume a game from the point at which play was suspended. The option of saving a game before any move or combat phase permits playing a game by correspondence. Saving a game is accomplished through the use of the (Q)uit command described in section 4.8.

## 2.5 Talking to the Computer

The computer will prompt you for whatever information is needed. These prompts will usually take the form of asking you to answer a question, enter a number, or select a command from a menu of options. After responding to each information request from the computer, complete your response by pressing the (return) key. To correct a mistake, use the (left arrow) key to backspace, then type over the mistake. Most inputs require only a single letter, except for the 2-letter movement commands described in section 5. Yes or No replies are entered by typing the single letter (Y) or (N). If the first letter of a possible response is enclosed in parentheses, it means that only that single letter should be entered; examples are the general commands described in section 4. In a few instances you may only have to press the (return) key. This technique is used either to select a "default" value, such as a power setting which will maintain current aircraft speed, or to resume program execution after pausing to permit viewing of displayed data.

# 3.0 Sequence of Play

Computer Air Combat is played in a series of game turns until all aircraft on one side are destroyed, or the engagement is terminated by mutual agreement. Each game turn consists of a standard sequence of phases.

## 3.1 Scenario Selection and Set-up Phase (Start of game only)

At the start of a game both players decide which scenario they want to play (see the Game Selection Card), the number and type of aircraft each player will control, and the starting location, scenario and options selected. Some of these starting conditions may be chosen randomly by the computer.

## 3.2 First Player Movement Phase

The first player secretly moves all of his aircraft. Before moving any aircraft, he may request aircraft position or status reports, or a global position plot.

## 3.2 Second Player Movement Phase

The second player, or the computer in solitaire scenarios, secretly moves all of his aircraft. Player 2 may also check position or status reports, or examine a global position plot before beginning movement. Any information on aircraft locations provided to Player 2 at this time will be as of the start of the turn; the results of Player 1's movement this turn is not made available to Player 2.

## 3.4 Second Player Combat Phase

The second player may now check the positions of all aircraft visible to him, and initiate combat against any enemy aircraft which are within range. All positions shown at this time are those resulting from movement during the present turn. Before initiating combat, he again has the option of examining position or status reports, or plots of aircraft locations.

## 3.5 First Player Combat Phase

The first player enters his password and checks for possible combat opportunities for his aircraft, in the same manner as the second player.

### 3.6 Combat Results Phase

The effects of any attacks conducted during the preceding combat phases are determined, and damage recorded. The computer checks to see if all aircraft on either side have been shot down, thus ending the game. If not, the next turn begins with the First Player movement phase.

## 4.0 General Commands

At the beginning of each movement and combat phase there are several commands available to the player. These commands are described in this section and summarized on the Game Information Card.

### 4.1 Position Report (P)

Displays the position, course, speed, and bank and nose attitude of all friendly aircraft and all visible enemy aircraft. In the Night Fighter scenario, if no enemy aircraft are visible, a radar contact report on the currently assigned target will be given.

### 4.2 Status Report (S)

Provides information on the amount of damage an aircraft has taken and on the amount of ammunition remaining. Damage categories and their interpretation are:

| | |
|---|---|
| None | No damage |
| Hit | Less than 50% |
| Major | Between 50% and 75% damage |
| Critical | Greater than 75% damage |
| Out | Engine disabled (Multi-engine aircraft only) |

Ammunition supplies refer to number of attacks remaining for forward-firing guns only (turret guns do not run out of ammunition). Separate totals are shown for cannon and machine gun ammunition.

### 4.3 Global Plot (G)

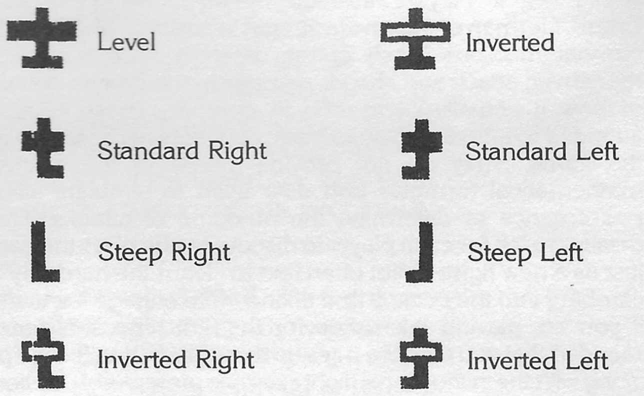
Plots all friendly and all visible enemy aircraft on an 80 kilofeet by 140 kilofeet display. The plot is initially centered on X = 0, Y = 0), but you have the option to re-center the global display on any point in the XY-plane. The X-axis and Y-axis are indicated on the plot, except when no longer present due to re-centering. When not centered at the origin, the global plot center is indicated by a small cross. The global plot is always oriented with north toward the top. Friendly aircraft are displayed as an open-centered rectangle; hostile aircraft as a solid square. Course, speed, altitude, etc., on all visible aircraft are available through the (P)osition command described in section 4.1. If present, the direction of the sun will be indicated by a solid color rectangle on the W, SW, S, SE, or E edge of the plot.

### 4.4 Movement (M)

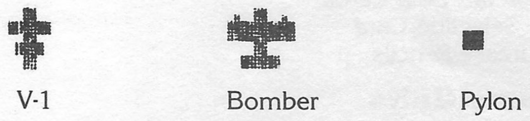
The movement command permits you to move all friendly aircraft, as described in section 5.0.

### 4.5 Tactical Plot (T)

Plots all aircraft visible in the immediate vicinity of a single friendly aircraft. This is the same plot which is shown when moving an aircraft, except that positions are shown at the completion of all movement. This command is normally used to decide whether or not to initiate combat by seeing if there are any enemy aircraft which can be attacked. A firing arc is plotted in front of your aircraft to aid in determining whether there are any aircraft in position to be attacked by your forward-firing guns. The tactical plot is aircraft-centered, and the top of the display is always in the direction of aircraft heading. A small window in the lower right-hand corner displays the compass heading of the display orientation, e.g., N, NW. The tactical plot extends 6 kft ahead, 2 kft behind, and 7 kft to the sides of the center aircraft. The length of each firing arc symbol is 2.5 kft, which provides useful distance reference during movement. The size of the aircraft symbols is not to scale; the length of each aircraft symbol is 0.45 kft, about 10 times the length of a WW II fighter. Symbols for aircraft which are within 0.45 kft of each other horizontally may overlap; however, collisions only occur when aircraft end a turn within .03 kft of each other. All friendly and visible hostile aircraft located within this 8 x 14 kft region are displayed oriented relative to the aircraft whose tactical plot is being presented. Aircraft outside this region can be plotted using the global plot described in the previous section. Friendly aircraft are indicated by a white identification stripe just forward of the tail. Hostile aircraft are a solid color and do not have this identification stripe. The bank attitude of each aircraft is visually indicated on the display. The following symbols are used to show the different bank attitudes:



Note that the three inverted attitudes are all indicated by a white stripe "painted" on the lower surface of each wing. The tactical plot perspective is always looking down from above on an aircraft, regardless of relative altitudes. You will notice a size increase in symbols plotted at a relative angle of 45, 135, 225 or 315 degrees; this distortion is introduced by the Apple hi-res graphics. The, following are the symbols used for V-1's, bombers in level flight, and air race pylons:



Bombers in level flight are shown with engine nacelles on the wings for ease of separating bombers from fighters, even though there are single-engined bombers and twin-engined fighters in the games. An (ID)entification option is available on the tactical plot to provide identity, course, speed, altitude, etc., on each aircraft displayed; this option is described in more detail in section 5.72.

### 4.6 Combat (C)

Checks all friendly aircraft to determine if there are any enemy aircraft which are subject to attack. You will be informed of each possible attack in order, and given the range, target aspect and type of guns available. You will then be asked if you want to make the attack or not. If you answer yes, the attack will be conducted and you will be informed whether or not your attack scored any hits. Each type of gun may only attack one target per turn.

### 4.7 Unload Aircraft (U)

Aircraft can begin the game loaded with either bombs or auxiliary fuel tanks. Loaded aircraft have degraded climb and dive rates , maneuverability, etc. At the start of each movement phase, you can use the (U)nload command to drop whatever load the aircraft is carrying and thereby improve your aircraft's performance (but with a possible penalty in victory conditions).

### 4.8 Quit (Q)

Suspends play of the game and asks if you want to save the current game conditions. After saving a game you are given the option of resuming play. If you do not save the game or resume play then the final results of the game will be displayed. It should be noted that the (Q)uit command is not shown on the command menus which are displayed. This command always may be given whenever the other command options in this rules section are available.

## 5.0 Moving Your Aircraft

Aircraft movement is controlled by maneuver commands which affect aircraft speed, direction, altitude, and bank and nose attitude. The response to each maneuver command will depend on the type of aircraft you are flying, its altitude, speed, whether or not it is loaded, and the amount of damage it may have sustained. All movement is assumed to occur simultaneously, although Player 1 moves all of his aircraft before Player 2 moves his aircraft. When moving an aircraft, the player will be presented with a tactical plot showing all visible aircraft up to 6-7 kft ahead and 2 kft behind the aircraft being moved, as described in section 4.5. Beneath the plot will be displayed the altitude, speed, initial heading, current heading, bank and nose attitude, maneuvers currently in progress, and distance already moved this turn. Information about maneuver capabilities at the aircraft's current speed and altitude can be obtained by using the CK command. Other aircraft displayed on the tactical plot can be identified using the ID command. These 2 non-maneuver commands are described in section 5.7.

### 5.1 Maneuvers

There are nine different maneuver commands available:

ST - Move aircraft straight ahead
RR - Roll to the right (clockwise)
RL - Roll to the left (counter-clockwise)
TR - Turn right
TL - Turn left
SR - Sideslip right
SL - Sideslip left
NU - Nose up
ND - Nose down

Each of the maneuvers, except for move straight (ST), require the aircraft to move a certain distance, based on aircraft type, speed and altitude, before the maneuver is executed. While this distance is being moved, the maneuver being executed is displayed as a "current maneuver." More than one maneuver of different types may be executed simultaneously, as long as a required nose or bank attitude is not changed during a turn, sideslip or half-loop maneuver. The computer will check the validity of all maneuvers and inform you whenever you attempt to execute an illegal maneuver. When you give the ST command the computer will ask you how far you want to move (from 0.1 kft up to the distance remaining to be moved). If you simply type (return), the distance moved will be the amount necessry before the next completion of a maneuver in progress. If there are no current maneuvers listed, then typing (return) will cause the aircraft to move the distance necessary to complete the current game turn. The remaining eight maneuver commands are described in sections 5.3–5.6.

### 5.2 Speed

The current speed of an aircraft is displayed in miles per hour, to the nearest 10 mph. During each game turn an aircraft will move, in kilofeet, a distance equal to its speed divided by 100. Certain maneuvers will immediately reduce an aircraft's speed, so that the distance moved in the current turn also will be reduced. All maneuver commands except ST cause a delayed speed reduction. Delayed speed losses are not applied until the end of a turn, and so may be offset by speed gains resulting from applying power or diving.

**5.21 Speed Regions** It is important to be aware of three speed limits for your aircraft: stall speed, maximum level speed and maximum dive speed. These three speeds are shown, in order, on the aircraft capabilities display (see section 5.71). Stall speed is a function of bank attitude, increasing by 10 mph when in a standard bank or inverted, and by 20 mph in a steep bank. If an aircraft's speed at the start of a turn is below stall speed, then it will enter a spin, unless it is on the ground (zero altitude). Aircraft can move below stall speed along the ground to taxi, take off or land. An aircraft in a spin will fall out of control at its maximum dive rate. It will move straight ahead the distance corresponding to its initial speed, but will end the turn with a randomly-determined heading. The speed gained in the dive will eventually end the spin when stall speed is once more exceeded. Maximum level speed is the highest speed an aircraft can attain in level flight. Maximum dive speed is the highest speed an aircraft can move normally in a dive. Speeds between level speed and dive speed can only occur as the result of acceleration due to gravity in a dive. On occasion a diving aircraft may exceed its maximum dive speed. If this should occur, the aircraft will become more difficult to control, with significant increases in the distances required to execute maneuvers — including pulling the nose up to come out of the dive!

**5.22 Speed Changes** Speed may be increased by diving or by the application of power. Speed decreases may occur as the result of maneuvers, climbing or reducing power. After all movement commands have been executed in a given turn, you will be asked to select a power setting, an integer value from 0 to 10. The available power range will be reduced, as required, to maintain speed above stall speed and below maximum dive speed. A power setting of 10 represents full throttle, while a setting of 0 represents all possible actions which can be taken to reduce speed, except climbing or maneuvering. The speeds which the upper and lower power settings will produce are provided to help in determining the proper power setting. Speed changes resulting from climbing, diving or maneuvers are automatically factored into the upper and lower speeds available. If the currently displayed speed of your aircraft is between the upper and lower speeds available, then you may maintain that speed by simply typing (return) instead of entering a specific power setting.

### 5.3 Roll Maneuvers (RR, RL)

Roll maneuvers are used to change an aircraft's bank attitude. There are eight possible bank attitudes:

| | |
|---|---|
| LV | Wings level in normal flight |
| R1 | Standard right bank |
| R2 | Steep right bank |
| IR | Inverted right bank |
| IV | Wings level in inverted flight |
| IL | Inverted left bank |
| L2 | Steep left bank |
| L1 | Standard left bank |

A change from one bank attitude to an adjacent attitude will result from a one-point roll. If the roll is to the right (RR command), the bank attitude will change to the next lower attitude on the above list, e.g., from LV to R1. A one-point roll to the left (RL command) will cause a change to the next higher attitude on the list, e.g., from L1 to L2. When either the RR or RL commands are given, you will be given the option of rolling from 1 to 4 points (a 4-point roll is referred to as a half-roll). Rolling 2 or more points with a single command can be accomplished more rapidly than rolling the same number of points with a series of 1-point rolls, since in the latter case additional time is required to stop at each intermediate bank attitude. Each roll maneuver causes a delayed speed reduction of 10 mph.

## 5.4 Turn Maneuvers (TR TL)

A turn maneuver will cause a 45-degree change in an aircraft's heading in the direction of the turn. A turn to the right (TR) can be made in an R1, R2 or IR bank attitude. An aircraft must be in an L1, L2 or IL bank in order to make a left turn (TL). Turns made in the R2 and L2 bank attitudes can be made in one-third the distance required for the other four attitudes. There is, however, both an immediate speed reduction of 20 mph and a delayed speed reduction of 30 mph for each turn maneuver made in an L2 or R2 bank. Turns made in the R1, IR, L1 or IL attitudes suffer only a 10 mph delayed speed reduction. An aircraft which is moving below stall speed along the ground may turn either direction while in a LV bank attitude.

## 5.5 Sideslip Maneuvers (SR, SL)

The sideslip maneuver is used to move an aircraft to the side without a change of heading. The maneuver can only be made in a standard or inverted bank attitude. A sideslip to the right (SR) is possible when in either an R1 or IL bank attitude. An aircraft must be in an L1 or IR attitude in order to execute a sideslip left (RL). Note that when inverted, the sideslip will move the aircraft in the opposite direction from the bank. This is because a sideslip always occurs in the direction of the lower wing. A sideslip will result in a loss of 0.3 kft in altitude and a sideways movement of 0.3 kft. The altitude loss occurs immediately upon completion of the maneuver and is separate from any changes specified as a result of climbing or diving. There is an immediate speed reduction of 30 mph due to a sideslip, and a 20 mph delayed speed loss.

## 5.6 Pitch Maneuvers (NU, ND)

Pitch maneuvers are used to bring the nose of your aircraft up (NU) or down (ND). There are five possible nose attitudes for an aircraft:

| | |
|---|---|
| H2 | nose up in steep climb |
| H1 | nose up in normal climb |
| LV | nose level |
| L1 | nose down in shallow dive |
| L2 | nose down in steep dive |

The NU command will cause the nose of your aircraft to move to the next higher attutude on the above list, unless already in the H2 attitude. Similarly, unless in the L2 attitude, the ND command will move the nose of your aircraft to the next lower attitude. Issuing the NU command in H2 nose attitude or the ND command in L2 attitude will put your aircraft into a half-loop; this maneuver is discussed in section 5.63. For an aircraft in a steep bank attitude, an NU command executed while in a steep dive (L2 nose attitude) will result in a 45-degree heading change in the bank direction, and a simultaneous change from steep bank to standard bank attitude, e.g., R2 to R1.

### 5.61 Climbing

The nose of your aircraft must be in the H1 or H2 nose attitude in order to gain altitude by climbing. Aircraft in a steep bank attitude, R2 or L2, can only climb if in H2 nose attitude; for them the H2 attitude is like H1, and H1 is equivalent to LV. The H1 attitude is used for normal climbing, while the H2 attitude is used only to trade speed for altitude in a "zoom" climb, or to enter a climbing half-loop. Inverted aircraft may not be in an H2 nose attitude. Maximum altitude gain for a complete turn spent in the H1 nose attitude is shown on the capabilities display obtained using the CK command (section 5.71); minimum altitude gain is 0.01 kft. Aircraft which spend more than half a turn in an H1 nose attitude must climb at least 0.01 kft, unless they are in a steep bank attitude. For purposes of making this determination, time spent diving will offset time spent climbing. Maximum climb ability while in the H2 attitude is increased by an amount which depends upon the speed and type of aircraft. Aircraft suffer a delayed speed reduction while climbing. This speed loss varies according to aircraft type, but is between 10 and 50 mph per 0.1 kft in altitude gain. Most aircraft have sufficient power available, particularly at low altitude, to offset the speed loss due to climbing, and thereby maintain a constant speed in a maximum climb at H1 nose attitude. Speed loss in a zoom climb will occur very rapidly, however, so that remaining in H2 attitude for more than one turn will usually result in a stall. The climb rate of an aircraft drops to zero at its ceiling (maximum altitude, which is indicated on the Aircraft Data Card).

### 5.62 Diving

Aircraft in an L1 or L2 nose attitude will lose altitude by diving. Altitude loss also occurs as a result of the sideslip maneuver, and for aircraft whose noses are level and are in a steep bank (L2 or R2) attitude. The maximum altitude loss indicated in the capabilities displayed using the CK command can only occur for a full turn spent in the L2 nose attitude. Minimum altitude loss in the L2 nose attitude is half of the maximum dive distance; this is also the maximum which can be lost while in the L1 nose attitude. The minimum altitude loss in the L1 attitude is 0.01 kft. If in a steep bank attitude, minimum altitude loss with the nose level will be between 0.1 and 0.2 kft; in the L1 nose attitude it will be half the maximum dive distance; and the L2 nose attitude forces an aircraft to dive its maximum amount. Aircraft which move more than one-half game turn with their nose down must dive a minimum of .01 kft. Time spent climbing will offset time spent diving in making this determination. Diving results in a delayed speed increase of between 10 and 30 mph for each .1 kft of altitude loss, depending on aircraft type. For most aircraft, speed will build up rapidly in a steep dive. Using minimum power will offset some of the speed build-up, but for many aircraft this will not be enough to allow it to spend very many turns diving its maximum amount before exceeding maximum dive speed. It is not advisable to exceed maximum dive speed, since distance which must be moved to execute maneuvers will be greatly increased.

### 5.63 Half-loops

Executing an NU command with an aircraft in H2 nose attitude will cause your aircraft to perform a climbing half-loop. Similarly, an ND command while in L2 nose attitude will initiate a diving half-loop. At the completion of a half-loop, an aircraft will undergo a bank attitude reversal (the equivalent of what happens in a half-roll) and a heading reversal. For example, an aircraft heading north in an L1 bank will complete a climbing half-loop heading south in an IR bank attitude. Half-loops cannot be performed in a steep bank (R2 or L2) attitude. An aircraft must be inverted in order to execute a diving half-loop, and cannot be inverted in a climbing half-loop. An aircraft therefore will complete a climbing half-loop in an inverted bank attitude, and since the H2 nose attitude is prohibited while inverted, the nose attitude will change to H1.

When executing a half-loop, aircraft must climb or dive a fixed distance; this distance depends on the speed at which the aircraft begins the maneuver. There is an immediate speed reduction of 10 mph when entering a half-loop, in addition to the delayed speed reduction of 10 mph associated with the ND or NU maneuver. It is advisable to enter a climbing half-loop at a relatively high speed to avoid a stall, and a diving half-loop at low speed to prevent maximum dive speed from being exceeded.

### 5.7 Check Capabilities (CK) and Identify Aircraft (ID) Commands

There are two non-maneuver commands which may be given during the movement phase. One of these commands is used to obtain information on the maneuver capabilities of your aircraft at its present speed and altitude; the other to identify aircraft appearing on the tactical plot.

**5.71 Check Capabilities (CK)** The CK command will provide a 3-line summary of the current capabilities of the aircraft you are moving. Below is a sample display of the information presented:

```
RR   .3      RL   .5      TR   3.9     SR   1.1
NU   .2      ND   .5      CL   .52     DV   1.09
PWR   — 20  TO  +50       SPD   90,330,420
```

The first line shows how far the aircraft must move to execute roll, turn or sideslip maneuvers. Only maneuvers which are possible in the current bank attitude will be displayed, so the aircraft in the example above must be in an R1 bank. If this airplane should roll right (RR) to an R2 attitude, then the top line would change to:

```
RR   .8      RL   .3      TR   1.3
```

The second line in the CK display indicates the distance which must be moved for pitch maneuvers, and the maximum climb and dive distances. The climb distance assumes a full turn in the H1 nose attitude and the dive distance a full turn in the L2 nose attutude. The last line shows the maximum amounts speed can be decreased or increased by changing the power setting; it also shows the limits for the different speed regions — stall speed, maximum level speed and maximum dive speed.

**5.72 Indentification Command (ID)** The ID command is used both to determine the identity of aircraft whose symbol appears on the tactical plot, and to obtain information about the altitude, speed, nose attitude, etc., of such aircraft. Below is an example of the information presented:

```
GE   V-1     #1            ALT   2.6      SPD   370
HDG   W      BNK   LV        NOSE LV
RANGE     4.9     ALTITUDE DIFFERENCE     -1.1
```

When the ID command is issued, one aircraft symbol on the display will begin flashing on and off. If you wish to obtain the above data on this aircraft, type (Y), but do NOT type (return). To move on to another aircraft, type (return) and a different aircraft symbol will start to flash. This selection process is continued until you have been given an opportunity to identify all aircraft on the screen.

## 6.0 Visibility

Sighting the enemy is an essential part of air-to-air combat. Many World War II pilots first became aware of the presence of enemy aircraft when they were attacked, and by then it was often too late! In computer Air Combat each player is made aware only of those aircraft which are currently visible to one of his own aircraft. The following factors determine whether or not an aircraft will be seen by an opponent.

### 6.1 Aircraft Type

The cockpit design, location and other structural features of an aircraft influence how difficult it is for its pilot or crew to spot other planes. Aircraft with multiple crew members can sight other aircraft more readily than can single-seat fighters. In the game, each aircraft type is rated for visibility in 12 separate relative bearing and altitude sectors.

### 6.2 Enemy Aircraft Size

The larger an airplane, the farther away it can be seen. Each aircraft has a size factor which determines both how for away it can be spotted and how easy it is to hit when fired upon.

### 6.3 Enemy Aircraft Relative Location

Relative bearing and altitude have the greatest influence on visibility. An aircraft directly ahead can be detected at ranges about 25 times greater than one directly behind. Aircraft are also easier to spot if they are near or above your own altitude.

### 6.4 Relative Motion

An aircraft which is moving directly towards or away from you is more difficult to see than one which is moving across your field of view.

### 6.5 Environment

Scenarios can occur either during daylight or at night. Night visibility ranges are considerably less than during daytime. The location of the sun, if present during day scenarios, can significantly affect visibility. Aircraft are much harder to spot if you have to look for them into the sun. There is a 50% chance of the sun being present for daytime scenarios starting at 5 kft or below. This probability increases slightly for higher starting altitudes, reflecting the increased likelihood of action taking place above the clouds.

### 6.6 Pilot Quality

An ace often got that way partly by being able to see enemy aircraft before they saw him, and this ability is reflected in the game. An inexperienced pilot, on the other hand, is not able to spot other aircraft as well as an average pilot.

## 7.0 Combat (C)

The (C)ombat command will initiate a check for all possible opportunities for friendly aircraft to attack enemy aircraft. As each opportunity is determined by the computer, you will be given the option of whether or not to make the attack. This procedure continues until all attack possibilities have been presented. After both players have completed their combat phases, a damage report will be displayed, showing all aircraft which were damaged or destroyed.

### 7.1 Aircraft Armament

There are two basic types of armament: forward-firing guns and turret guns. Forward-firing guns can fire only at targets located in front of the aircraft. Turret guns have fields of fire which vary according to the type of aircraft.

**7.11 Forward-firing Guns** All fighters have forward-firing guns as their principal armament. There are two different varieties of forward-firing gun: Cannon (CN) and Machine Gun (MG). In the game, the only difference between these two varieties is in their ammunition supply, which is described in more detail in section 7.4. Each forward-firing gun has a firepower factor associated with it, which is used to calculate the damage it can inflict on another aircraft. The number of forward-firing guns, their type and firepower, are indicated on the airplane characteristics card. This information is also obtainable using the (S)tatus command (section 4.6). Any guns which have been knocked out as the result of an enemy attack will not appear on the Status display. For each aircraft with forward-firing guns there is a firepower quality parameter which indicates the relative quality of the aircraft as a firing platform. Firepower quality includes such factors as the location of the guns and the quality of the gunsight. The firing arc of forward-firing guns extends 45 degrees to the side (as shown by the firing arc lines on the tactical display), and 45 degrees above and below the firing aircraft. Each up or down shift in the nose attitude moves the vertical firing arc limits up or down 45 degrees.

**7.12 Turret Guns** All bombers and some twin-engined fighters in the game have turret guns. The firepower of all turret guns possessed by an aircraft is represented by a single factor which varies according to the relative location of the target. Therefore all turret guns must fire at the same target in a single turn. Relative target location is expressed in terms of whether the target is above, below, or at nearly the same altitude as the firing aircraft, and whether it is ahead, ahead and to the side, behind and to the side, or behind.

### 7.2 Attack Effectiveness

Several factors influence whether or not an attack will be successful in hitting the target aircraft. The most important is firing range, followed by target aspect. Other factors include target size, pilot quality, maneuvers performed by the firing aircraft, and its firepower quality parameter. The maximum firing range is 2.5 kft, where there is less than a 50% chance of hitting a bomber-sized target from behind. The likelihood of successful attack increases steadily as range decreases, until almost any attack from within 0.4 kft will score some hits. The number of hits scored on the target from a successful attack is primarily a function of the firepower factors of the firing aircraft and the firing range.

### 7.3 Damage Assessment

Damage assessment occurs at the conclusion of both players' combat phases. The number of hits scored on each target aircraft from all attacks on it are allocated to various parts of the aircraft: wings, fuselage, cockpit, engine and guns. This allocation is based on a random distibution corresponding to the general type of aircraft. The total damage received by each part of the aircraft that was hit is compared to the maximum damage which can be taken by that particular part. Once the maximum is exceeded for any one part, the aircraft is destroyed. There is a slight chance of scoring a critical hit which would destroy the aircraft each time a cockpit, engine or wing is hit. These critical hits correspond to hitting the pilot, a crucial engine part, or igniting the fuel tanks. The extent of damage received by an aircraft is known only to the player who controls it, and is obtainable using the (S)tatus command (section 4.6). The player making the attack is told only whether or not any hits were scored.

### 7.4 Damage Effects

Damage received by an aircraft can affect its performance characteristics, as described below.

**7.41 Cockpit Hits** Aircraft which have received cockpit hits become more difficult to maneuver, because of injuries to the pilot or damage to instruments or controls.

**7.42 Engine Hits** Hits on the engine result in reduced power and climb rate. Multi-engine aircraft can continue to fly as long as they still have at least half of their engines operating. Each engine which is lost will reduce maximum level speed as well as power and climb rate.

**7.43 Fuselage Hits** Fuselage hits on aircraft with turret guns have a slight chance of reducing the total turret firepower.

**7.44 Gun Hits** Each gun hit on an aircraft with forward-firing guns will knock out one gun. If there are no forward-firing guns, then turret firepower is reduced by one factor.

**7.45 Wing Hits** The effect of each wing hit is to reduce the maximum level speed and maximum dive speed of an aircraft.

### 7.5 Ammunition Supply

Each attack conducted by a plane with forward-firing guns will reduce the ammunition supply by one for each type of gun (CN or MG) firing. When the ammunition supply for a gun type is reduced to zero, then that type of gun may no longer fire. The current ammunition supply is indicated on the (S)tatus display (section 4.6). Turret guns are assumed always to have an adequate supply of ammunition.

## 8.0 Scenario Selection

The five scenarios in Computer Air Combat are described on the Game Selection Card. Briefly, the Air Race scenario permits you to hold multi-player air races, to learn the procedures for moving an airplane in the game if you have not done so before, or to become more familiar with the maneuver characteristics of a particular aircraft type. The V-1 Intercept and Night Fighter scenarios challenge the solitaire player to intercept and destroy randomly-appearing targets while flying a single aircraft. The Bomber Formation Intercept and Dogfight scenarios provide the opportunity to have several aircraft controlled by each player. The computer "Otto" pilot will also control the Player 2 aircraft to permit solitaire play of these two scenarios. Starting conditions either can be selected by the players or chosen at random by the computer. You can use your imagination or knowledge of actual World War II aerial engagements to set up your own scenario variations.

## 9.0 Familiarization Flight Example

This section describes the first few turns of a familiarization flight in a P-47D. This description is intended to help players learn some of the procedures involved in flying an aircraft in Computer Air Combat. It is recommended that new players follow the play of this example using their computer.

### 9.1 Scenario Set-Up

After loading the program from the game disc you will first indicate that you want a (N)ew game, and then select scenario 1. Next specify that you don't want an air race course set up, that you want 1 aircraft, and that it is a US P-47D (Type Index 4). When asked to enter a speed and altitude, select a speed of 300 mph and an altitude of 25 kft.

### 9.2 Maneuver Examples

When Turn 1 begins, you will be shown a menu of command options. Select (M)ove aircraft and you will shortly see a tactical display for your aircraft, with status information and a request for a maneuver command below the plot. Let's first try a standard turn to the left. We must be in an L1 bank attitude to make this turn, so our initial maneuver command is RL (roll left) 1 point. Now move straight until the roll maneuver is completed by executing the ST command, followed by (return) when asked "How Far (.1-3)?". Now initiate the turn maneuver using the TL command, and again move straight until the maneuver is completed. This time, however, the game turn ends without having completed our left turn. We end Turn 1 by using maximum power, 10, to increase speed to 330.

At the start of Turn 2 movement we see that TL still shows as a current maneuver. Moving straight to complete this maneuver, we find that it takes an additional 2.6 kft, making an overall total of 5.1 kft. Now let's try a left turn in a steep bank attitude. First we must roll left 1 more point; this maneuver is completed in 0.3 kft. Next enter the TL command and notice that our speed drops to 310. Move straight to complete the game turn, using maximum power to maintain a speed of 310.

For Turn 3, let's move straight until our left turn is completed (1.6 kft), and then for the remainder of the game turn. At the end of this turn, even though our nose is level we must lose at least 0.2 kft since we are in a steep bank. Losing this altitude does have the effect of permitting us to build our speed up to 370, if desired. However, let's prepare to enter a diving half-loop next turn by cutting our speed to 300 (power setting 0).

In order to execute a diving half-loop, we must be inverted and drop the nose below L2. We can initiate both actions simultaneously by entering the ND and RL (1 point) commands at the start of Turn 4. Moving straight, we find that the ND command is completed first, after moving .3 kft, and we issue another ND command at that point. Continuing to move straight, .9kft. Execute ND, followed by ST, which ends the game turn and competes the half-loop, with our aircraft heading S in an R1 bank altitude. Note the large dive distance and speed increase which has occurred during the diving half-loop — now it is clear why we cut back on power at the end of Turn 3! And with that observation, we leave you to continue this familiarization flight on your own.

# 10.0 Hints on Tactics

Tactics employed by successful fighter pilots in World War II are the same tactics which will lead to success in Computer Air Combat. Some of these basic tactical principles are presented here to help increase your enjoyment of the game.

## 10.1 Expect the Unexpected

Finding the enemy is the first step in any conflict. Obviously you can't shoot what you can't see, yet it's all too easy to be shot at by a plane you have not seen. So any time you have not spotted any hostile aircraft, be on the lookout. Change the heading of your aircraft every now and then in order to vary your blind spot, and possibly upset the timing of an unseen aircraft which may be setting up for an attack on you. Be especially wary of attacks out of the sun, or from behind and below. If you have more than one aircraft, position and maneuver them so that they can mutually support each other.

## 10.2 Be Aggressive

Fighter pilots are fundamentally offense-minded. Good defense may win football or basketball games, but it usually won't work in a dogfight; the best defense here is truly a good offense! Step one of being aggressive is to point the nose of your aircraft at the enemy. Whenever you turn away from an opponent you run the risk of losing sight of him, or worse yet, finding him on your tail. Make a head-on pass, if necessary, and then maneuver to again point your aircraft's nose at your opponent as quickly as possible.

## 10.3 Know Your Aircraft

Each type of aircraft has a different combination of strengths and weaknesses. It is important to know your aircraft's strengths and weaknesses relative to your opponent's aircraft. Among the most essential performance characteristics are turn rate, climb rate and dive rate, particularly how these vary with speed and altitude. Acceleration and deceleration ability, and maximum and minimum speed values are also important. Once you know your relative strengths, exploit them! Use superior climb rate to gain an altitude advantage whenever possible. Fight "in the horizontal" by turning towards your opponent if your airplane has a better turn rate. Use superior acceleration in a dive to build up speed more quickly, or to escape when in trouble. If your aircraft's performance improves more than your opponent's at a higher or lower speed or altitude, then attempt to move the engagement in that direction. When attacking bombers, usually it is safest to attack from below and either directly ahead or behind, and at as high a speed as possible.

## 10.4 Conserve Speed and Altitude

Speed and altitude are both easily lost in a dogfight, so it is important not to lose either needlessly. These two factors are somewhat interchangeable, since you can trade altitude for speed by diving, and speed for altitude in a zoom climb. Acquire and maintain an altitude advantage whenever possible, since this will usually permit you to initiate an attack when you choose to do so. Maneuvers will cost you speed, so it's usually a good idea to keep your speed up when not maneuvering.

# 11.0 Designer's Notes

Achieving a proper balance between realism and playability is one of a game designer's foremost challenges. Our intent in designing Computer Air Combat was to create a game that was first and foremost interesting and fun to play, but would still contain enough realism to give players the "feel" of tactical aerial combat. Another design philosophy was to place greater emphasis on involving players in the decision-making process (e.g., climb, turn, accelerate) of flying a plane in combat, and less emphasis on the mechanical process (e.g., stick and rudder movements). The game design also reflects the unique advantages afforded by computers in permitting the use of incomplete information regarding hostile aircraft locations and extent of damage, and in taking care of the numerous record-keeping details, thus allowing the players to concentrate on the more exciting aspects of the game. Players are given both a Commander's overview perspective,by being able to fly more than one plane at a time and view a global plot of the action, and a pilot's perspective when it comes to moving each individual aircraft.

The selection of which aircraft to include in the game was not easy. The original plan was to focus on about a dozen of the most famous allied and axis fighters, but the list rapidly expanded to the present three dozen fighter and bomber types, and it easily could have increased still more. The final decisions on aircraft types and variants to include were made on the basis of providing a balance of early ('39–'43) ad late ('44–'45) types, and of providing principal opponents on both sides of the major aerial compaigns of World War II — the Battle of Britain, the Pacific carrier battles, and the strategic bombing offensives against Germany and Japan. Considerable effort was expended to make the performance data as accurate and consistent as possible, and numerous sources were used in this process. Unfortunately, these sources were not uniformly complete or consistent in the data presented. Qualitative comments and judgements therefore had to be relied upon in several instances, It is our hope that any disagreements with these design decisions will not detract unduly from the enjoyment of what we believe is fundamentally a fun game to play.

— Charlie Merrow, Jack Avery.

⬡ **NO** Firepower Area

░ **LOWEST** Firepower Area

# HISTORICAL BACKGROUND

▒ **MEDIUM** Firepower Area

⬢ **HIGHEST** Firepower Area

From the close air support strikes flown by German Stukas in Poland in 1939 to the fire-bomb and atomic bomb attacks conducted against Japan by U.S. B-29's in 1945, airpower remained a major factor in all theatres of World War II. Control of the air, essential in any sustained campaign, was gained primarily by fighters engaging in, and winning, battles for air superiority over opposing fighters. Whether it was Zeros over Indo-China, Messerschmitts over France, Spitfires over England, or Mustangs over Germany, it was the fighter aircraft, and the pilots who flew them, that decided who obtained air superiority.

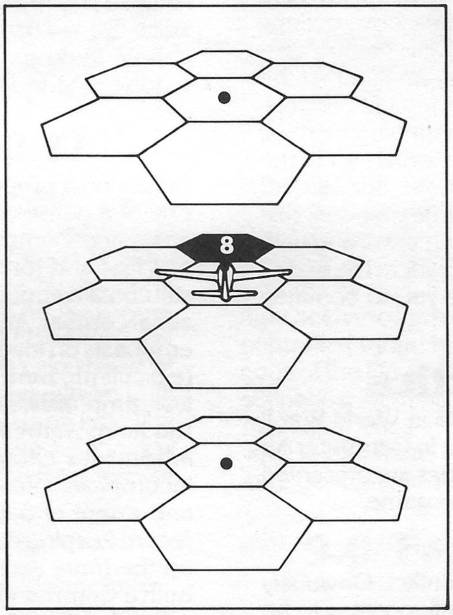
**Computer Air Combat** is a game which puts you in the cockpit of some of the most important fighters of Germany, Japan, Great Britain or the United States to match your skills against opposing fighters and/or bombers in re-creations of critical battles for control of the air. The following paragraphs provide a brief sketch of the air operations conducted by these four countries during World War II and the role played by the various aircraft represented in Computer Air Combat.

## UNITED STATES

The U.S. really fought two quite different air wars, one in Europe against Germany and another in the Pacific against Japan. In Europe, the United States was committed to a sustained daylight strategic bombing campaign against Germany. Most air combat involved U.S. long-range fighters in support of massed bomber formations against intercepting German fighters. In the Mediterranean, and in France and Germany following the Normandy invasion, U.S. fighters also undertook low-altitude attack missions in support of ground operations; however, these missions could only be undertaken successfully after the air superiority issue had been decided. Much of the air combat in the Pacific early in the War was conducted by the Navy, and was associated with naval combat between opposing carrier forces. Later in the War, the Navy Marine air activity shifted more towards the close support of island invasions. The Army Air Corps in the Pacific was initially involved in a defensive struggle against superior Japanese air power, but their role eventually evolved to the support of a strategic bombardment campaign against Japan similar to that conducted in Europe.

The following United States aircraft types are included in Computer Air Combat:

### P-40C (WARHAWK)



The P-40 was one of only two fighter types in use by the U.S. Army Air Corps at the outbreak of WW II. The P-40C carried a slightly heavier armament than the 'B' version flown by the Flying Tigers in China, and was the version in use with the U.S. Army at the outbreak of the war in the Pacific. It was flown against the Japanese in the Philippines and the early campaigns over New Guinea, flying out of Port Morseby against the Japanese at Lae. The P-40C was also flown by the British, who called it the TOMAHAWK, in the Western Desert. The P-40C was a rugged aircraft which could absorb much punishment, and it provided a stable gunnery platform. However, it could not turn with most of the Japanese or German fighters it was called upon to combat, and often was required to display its robustness to the full.

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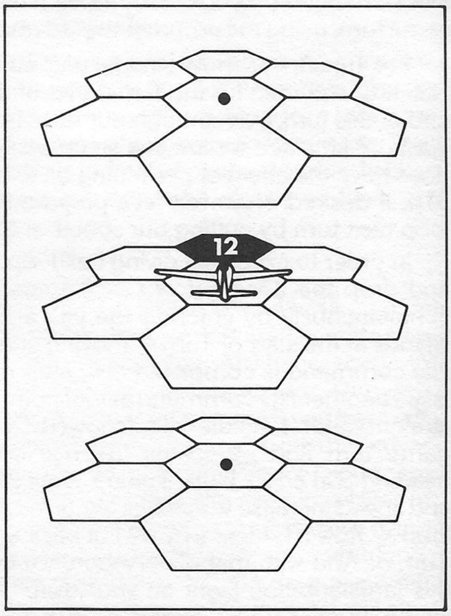
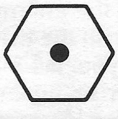
Number in hex refers to actual firepower units in this area.

### P-38G (LIGHTNING)



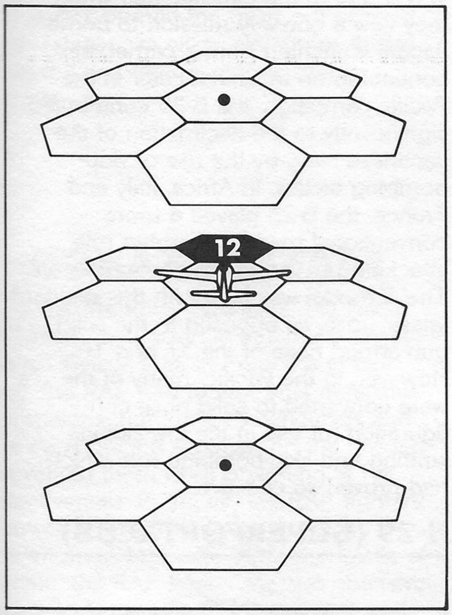
The P-38 was the other U.S. Army Air Corps fighter available in December of 1941, although only 68 of them were in the inventory at that time. Heavily armed, fast, with a good rate of climb and a spectacular diving acceleration, the P-38 was one of the very few successful twin-engined fighters in the Second World War. The 'G' version entered service in late 1942, and saw service in the Pacific in the Solomons campaign and on New Guinea, in the Middle East, and over Europe. Unable to turn with any of its opponents, it was extremely effective in the vertical plane, diving to the attack at very high speed, then using that speed and its excellent initial climb rate to zoom back to altitude for another pass, or continue its dive to pull away from danger. The 'Fork-Tailed Devil' was both feared and respected by its opponents.



This hexagon denotes the x-y coordinates directly above and below the airplane. In the rare event that one plane ends a turn directly above another plane, the computer will determine the firing aspect by comparing the compass headings of the two planes.

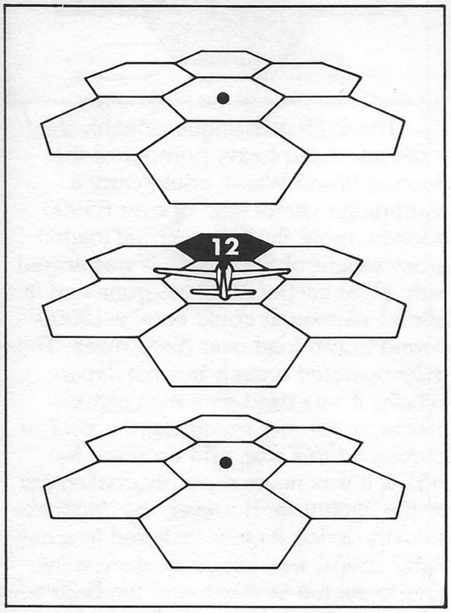
(It is very often possible for turret guns to fire at the points directly above and below a plane.)

## F4F-4 (WILDCAT)



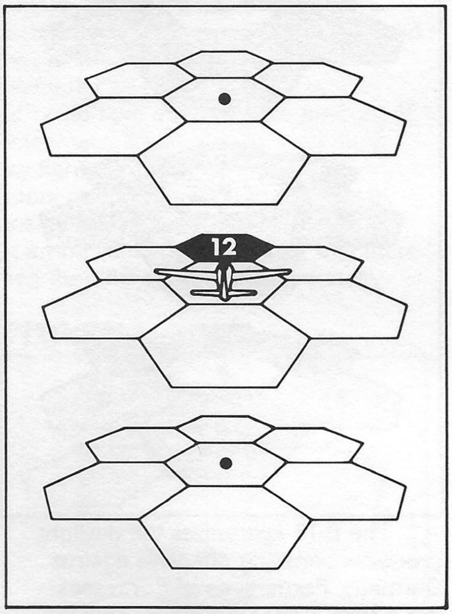
The Grumman-built WILDCAT was the standard carrier-based fighter of the U.S. Navy in the first year of the war in the Pacific. It was one of the few fighters of the period which could meet the Japanese ZERO on roughly equal terms. While it could not match the ZERO's maneuverablilty or climb rate, it could absorb more damage and could stay with the ZERO in level flight and out-run it in a dive. Later versions of the F4F were used aboard the Navy's small carriers for close support and air cover for many island invasions.

## F6F-3 (HELLCAT)



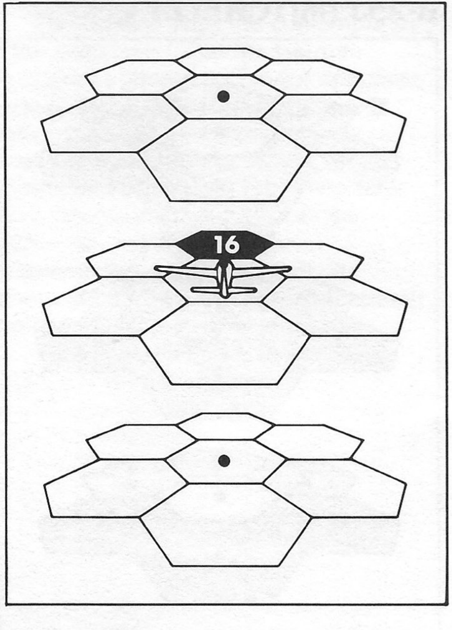
The HELLCAT was the standard U.S. carrier-based fighter from the middle of 1943 to the end of the war. It was the first carrier-based fighter clearly superior to the ZERO in overall performance. The HELLCAT possessed extremely good acceleration, fire-power, and climb rate and was surprisingly maneuverable for such a powerful fighter. Eighty-five percent of all hostile aircraft destroyed by U.S. carrier-based fighters was credited to the HELLCAT.

## F4U-1 (CORSAIR)



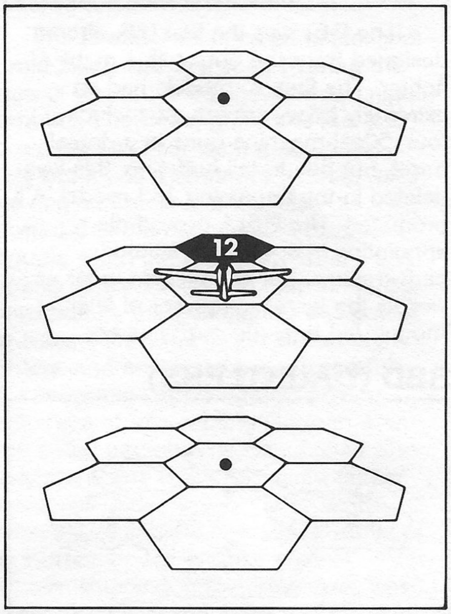
The CORSAIR was designed to be, and eventually was, a carrier-based fighter. However, it achieved most of its fame in WW II as a land-based fighter flown by the Marines. Faster than the HELLCAT, and an extremely stable gun platform, the CORSAIR flew as an escort, interceptor, ground-attack aircraft, and night fighter. The CORSAIR was known to the Japanese as 'Whistling Death'.

## P-47D (THUNDERBOLT)



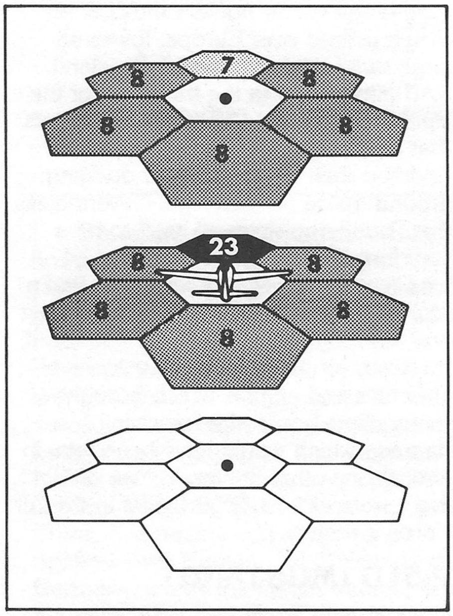
The P-47 was one of the two major long-range escort fighters the U.S. Air Force utilized over Europe. It was so large that, when it arrived in England, RAF pilots used to the trim lines of the Spitfire suggested to Thunderbolt pilots that they might take evasive action by undoing their harnesses and dodging around inside the fuselage! Nevertheless, the Thunderbolt proved itself to be a very formidable fighter. It possessed excellent firepower, was very fast, had a high roll-rate, and could out-dive almost any other fighter flying. It is most noted, however, for its extreme robustness of structure and engine, which brought many pilots home after receiving damage which would have been fatal in almost any other fighter. In May of 1945, there were almost 5600 P-47's in the Air Force inventory.

## P-51D (MUSTANG)



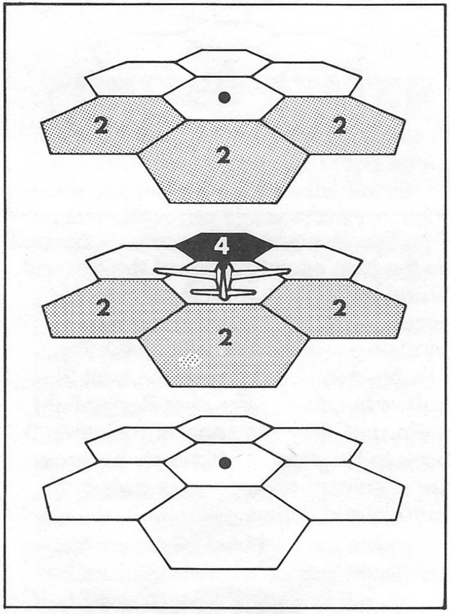
The Mustang is generally recognized as the best escort fighter of the Second World War. It was fast, maneuverable, accelerated rapidly, and the later 'D' models possessed excellent visibility. The Mustang could meet the best the Luftwaffe had to offer over Berlin, fight them until they ran short of fuel, then fly back to England. It ultimately became the dominant escort fighter over both Europe and Japan.

## P-61A (BLACK WIDOW)



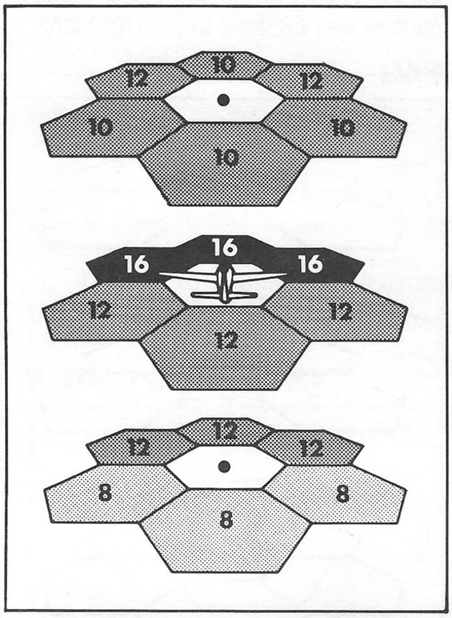
The P-61 was the first U.S. aircraft designed from the outset as a night fighter. The first 'A' models had an extremely heavy armament, including four .50cal machine guns in a dorsal turret, but due to tail buffeting, this was deleted in the remaining 163 model 'A's produced. The P-61A proved disappointing in speed and altitude performance, but its excellent radar as well as the increased power of later models led to a successful career.

## SBD (DAUNTLESS)



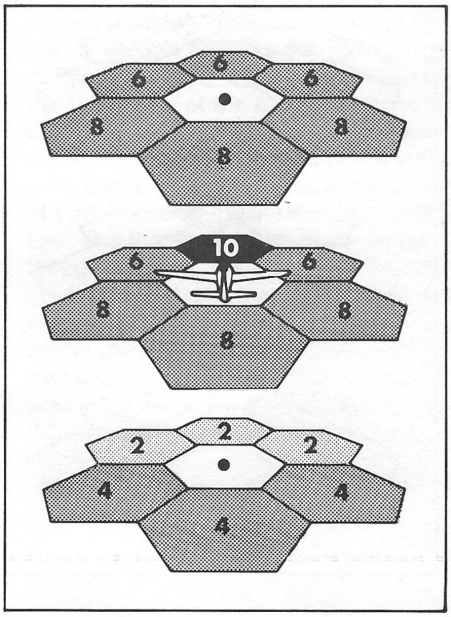
The SBD was the standard Navy dive bomber at the time of Pearl Harbor and saw extensive action in the pivotal Pacific battles at Coral Sea, Midway, and in the Solomons. It was noted for its ability to absorb battle damage, and in fact had the lowest loss rate of any U.S. carrier combat aircraft in the war. The SBD was as maneuverable as many fighters, and on occasion was used in the role of a fighter to fly defensive air patrols.

## B-17G (FLYING FORTRESS)



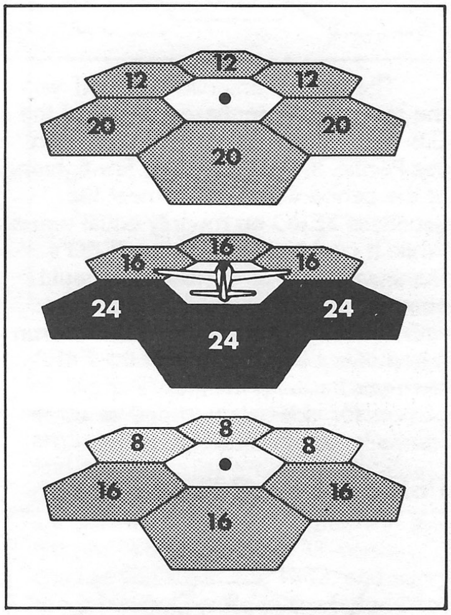
The B-17 epitomizes the daylight precision bombing offensive against Germany. Formations of Fortresses more than 1000 strong were flying against German industries in 1945, bombing the heart out of the German synthetic fuel resources. In 1943 and 1944, however, the success of the bomber offensive was determined by the ruggedness of the B-17, and the ever-increasing range of the escorting fighters. The major U.S./German air battles were fought by and for the B-17 formations. The 'G' model was characterized primarily by the head-on attacks preferred by the German fighters.

## B-25J (MITCHELL)



The B-25 became famous early in WW II due to the Doolittle raid where they flew a one-way mission to bomb Japan, launching from a carrier, and continuing on to China. Later in the Pacific campaign, the B-25 contributed significantly to the decimation of the Japanese Navy by the use of skip-bombing tactics. In Africa, Italy and France, the B-25 played a more conventional medium bomber role, attacking rail yards, military targets, etc. The'J' model was built with the standard 'glass' nose, as opposed to the solid gun-armed nose of the 'G' and 'H'. However, in the Pacific, many of the 'J's were converted to solid nose configuration for use in the low-altitude strafing and skip-bombing role which had proved so effective.

## B-29 (SUPERFORTRESS)



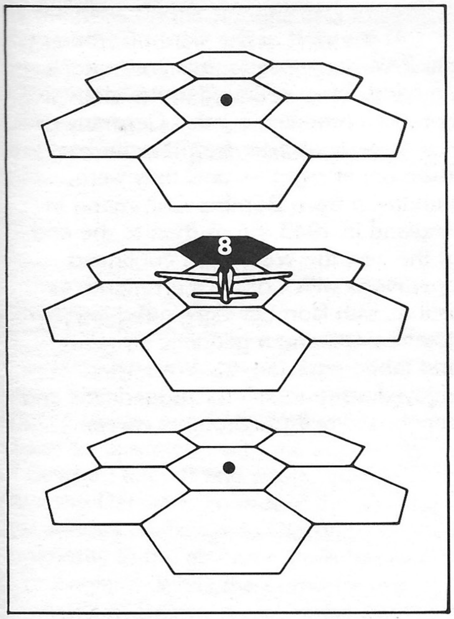
The B-29 was unquestionably the most advanced heavy bomber of the Second World War. It could carry a short-range useful load of over 65000 pounds, more than the normal loaded gross weight of the B-17G. It was armed with 12.50 caliber machine guns and a 20mm cannon. It could carry a 10000-pound bomb load over 3200 miles. The B-29 operated entirely against Japan. Initially, it was used as a high-altitude precision bomber much like the B-17 in Europe. In this role, and escorted by P-51's, it was never seriously challenged by the Japanese. However, the Japanese industry, being largely scattered in small 'light' shops, was not particularly vulnerable to such a strategy, and the B-29's role was changed to that of a low-level night bomber, carrying massive loads of incendiary bombs. The Japanese night-fighter defenses proved so inadequate, that most of the defensive armament was stripped from the B-29's, further increasing their offensive load. In a series of devastating nighttime attacks, the B-29's burned the heart out of most major Japanese cities, except for those reserved as possible atomic bomb targets.

## GREAT BRITAIN

For the Royal Air Force, the Battle of Britain in 1940 truly was their "finest hour." Before that, in France and Norway, the RAF had fought brief defensive campaigns, but logistics difficulties and the deteriorating situation on the ground prevented them from operating at full effectiveness. In the air, the RAF fighters showed themselves to be a match for the German Luftwaffe. After the Battle of Britain, the RAF began modest offensive operations over France in the day, and conducted a long and extensive night campaign, both offensively and defensively, which equalled the American daylight bomber campaign. In the Mediterranean, the RAF fought a fairly even and very tactically oriented campaign against the Germans and Italians. After the early battles in Indo-China, the British were pretty much out of the Pacific battles until very late in the war.

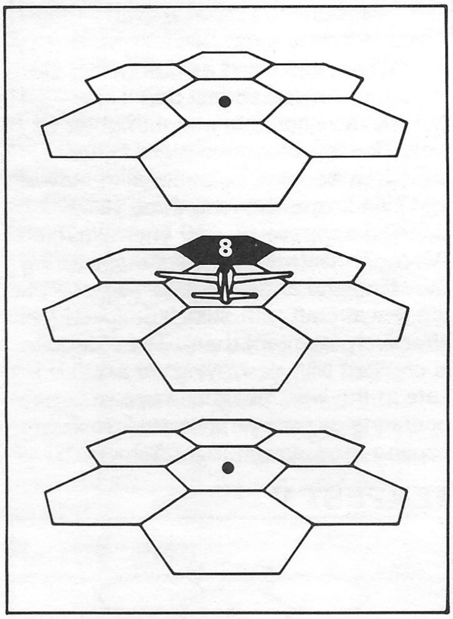
The following British aircraft types are included in Computer Air Combat:

### HURRICANE I



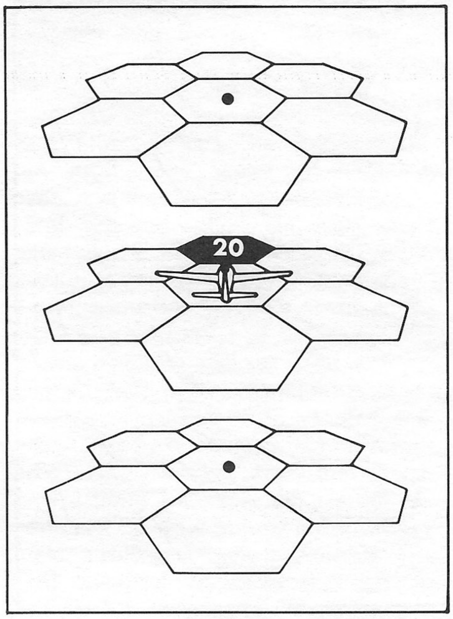
At the start of World War Two, there were 315 Hurricanes operational with the RAF. During the Battle of Britain, Hurricanes outnumbered Spitfires by almost two to one. The Hurricane was the primary RAF fighter in the Middle East in 1940 and 1941, as well as in the Far East in 1942. Later in the war, Hurricanes served as ground attack aircraft and night fighters. The Hurricane was an extremely significant fighter to the RAF in the early war years. The Hurricane I was the only variant produced through the middle of 1940. Its major opponent was the Me 109E, which possessed a significant speed and dive rate advantage. However, the Hurricane I was more maneuverable, and could take a remarkable amount of punishment. It was also an extremely easy fighter to fly and land, a very important consideration to less experienced pilots. The Hurricane, although not an outstanding performer, was there when the RAF needed it desperately.

### SPITFIRE I

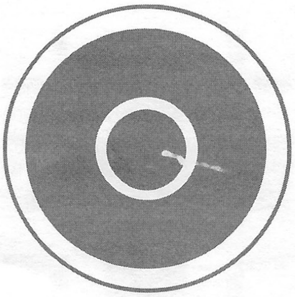


The Spitfire I was the contemporary of the Hurricane I, and the German Me 109E, its partner and major opponent, respectively, in the Battle of Britain. In that critical battle, the Spitfire was usually tasked with intercepting the fighter escort, while the Hurricane went about dead-even in speed, with the Spitfire holding a slight edge in maneuverability, but was generally inferior above 20,000 ft, and in firepower and diving ability at all altitudes.

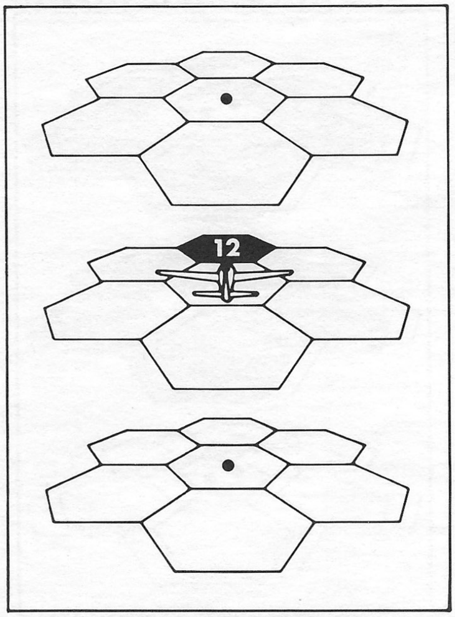
### BEAUFIGHTER I



The Beaufighter became operational in mid-1940, and was soon bearing the brunt of the action against German night bombers. The Beaufighter was fast and accelerated well for such a heavy aircraft, but it had a tendency to snap-roll if one engine was lost. It was also discovered that the nose tended to drop enough, when the heavy armament was fired, to cause the pilot to lose the target. Nevertheless, the Beaufighter was one of the most successful of the British night fighters, and also was used successfully as a long-range strike fighter, striking shipping and intercepting German maritime patrol aircraft. The Beaufighter also equipped some U.S.A.A.F. night fighter squadrons under 'reverse lend-lease'. Interestingly, the last operational sortie of the European war, a strike against German shipping in the Skagerrak, was carried out by Beaufighters.

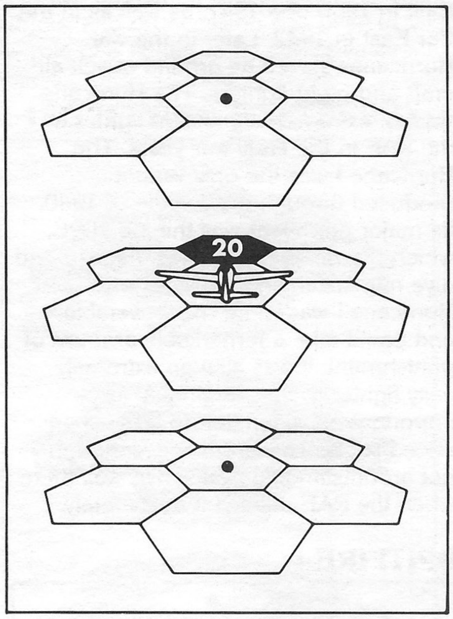


## SPITFIRE IX



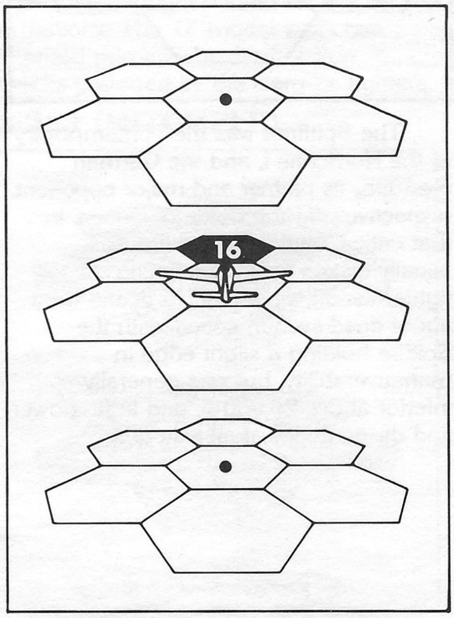
The Spitfire IX was basically the Spitfire VC with a Merlin 60-series engine. The Spitfire V was having a very difficult time combating the Me 109F, and was completely outclassed by the FW 190A. The 60-series engine was fitted to overcome this problem temporarily while the Spitfire VII and VIII were developed. The Spitfire IX significantly reduced, but failed to totally overcome the advantage held by the FW 190A. One interesting advantage it presented its pilots, however, was the fact that, at normal combat range, it was totally indistinguishable from the inferior Mk V. This occasionally caused Luftwaffe pilots to underestimate the potential acceleration and speed of their adversary. Even though the Spitfire IX was an interim design, it was used in greater numbers than any other Spitfire variant. Total production reached over 5500 aircraft.

## MOSQUITO N.F. II



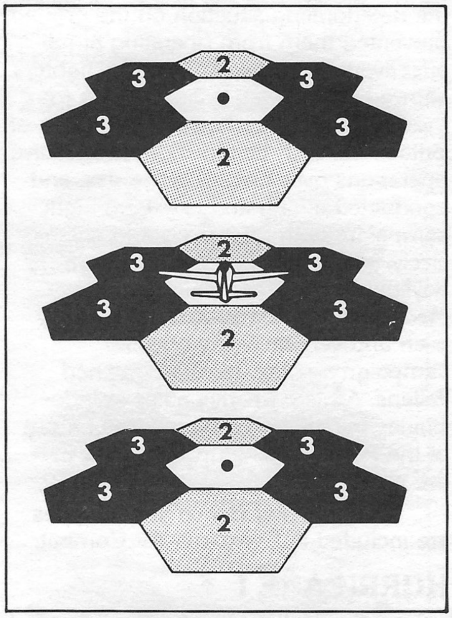
While conceived as a bomber, the Mosquito proved so fast that it was quickly developed as a night fighter as well. The first Mosquito night fighter squadron became operational in May of 1942 and, over the next three years, downed approxiately 600 enemy aircraft. When the German V-1 began appearing over England, the Mosquito was one of the few aircraft with sufficient speed to effectively intercept them. The Mosquito is credited with destroying over 600 V-1's. Late in the war, Mosquitos began operating as long-range intruders, intercepting the German night fighters.

## TEMPEST V



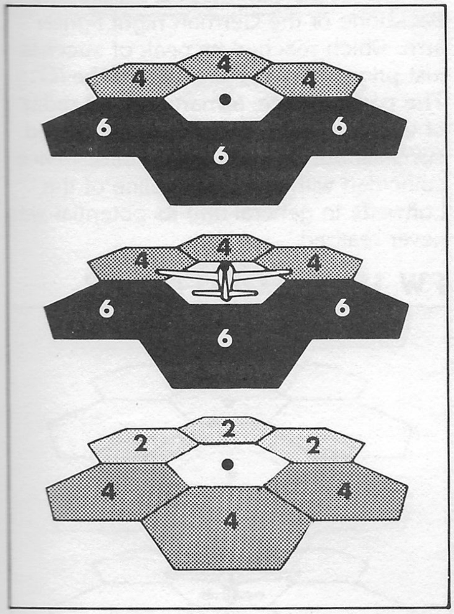
The Tempest V, the only Tempest variant to see combat in WW II, became operational in early 1944. The Tempest was a direct descendant of the Typhoon. It was a rather complete redesign, which was motivated by the desire to delay the onset of compressibility effects which were encountered by the Typhoon above 400 mph. The Tempest was an excellent low-altitude fighter, and was the first RAF fighter superior to the FW 190 at low altitudes. The Tempest truly proved its worth, however, when the V-1 attacks began. The Tempest, being the fastest low-medium altitude fighter in service with the RAF, became the mainstay of Britain's fighter defense against the V-1. The Tempest was also used over the continent in ground-attack and train-busting missions.

## WELLINGTON II



At the start of the war in Europe, the RAF had close to 200 Wellingtons on hand. They operated in the strategic bomber compaign against Germany — first in daylight then, from December 1939 on, at night — until they were withdrawn from Bomber Command in England in 1943. From then to the end of the war, the Wellington continued operations with Coastal Command, as well as with Bomber Command in other theatres. Utilizing a geodetic structure and fabric covering, the Wellington enjoyed a reputation for ruggedness and dependability throughout its career.

## LANCASTER I



The Lancaster was to Bomber Command what the Spitfire was to Fighter Command: an aircraft of which its crews were extremely fond and proud. The Lancaster evolved from the unsuccessful Manchester twin-engined bomber. Its first officially announced operation was a two-squadron daylight raid in April of 1942. Seven of the twelve aircraft dispatched were lost, and from then on, the Lancaster operated over Europe almost totally at night. The Lancaster became a common visitor to the night skies over Europe, and participated in some unique operations such as the raids on the Roehne and Eder dams with spinning mines, and the attacks on the battleship Tirpitz with 12000-pound 'TALLBOY' bombs. The Lancaster was a pleasant aircraft to fly, and handled well even when fully loaded.

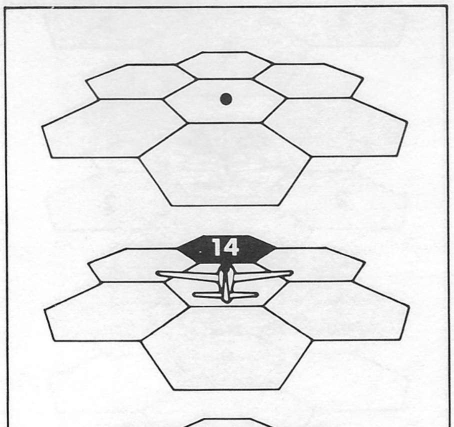
# GERMANY

The German Luftwaffe opened all of its early war campaigns with surprise attacks on the opposing air forces. These tactics, along with the superiority of German aircraft and pilots, quickly gave the Germans control of the air. The first serious challenge to German superiority in the air came from the RAF over England. While the Luftwaffe lost the Battle of Britain, it cannot be said that they were decisively defeated in the air and, in fact, destroyed more RAF fighters than they themselves lost. The issue was largely decided by the need to move the major strength of the Luftwaffe east to support the invasion of Russia. From that point on, the Luftwaffe was faced with a two-front war. In Russia, the Luftwaffe maintained control of the air for nearly two years until increasing Russian numerical superiority gradually prevailed. In the west, the combined strengths of the RAF, mainly felt along the French coast in the day and over German cities at night, and the US daylight offensive, gradually reduced the Luftwaffe to a shadow force. Consequently, the Luftwaffe gradually transitioned from a tactical offensive force, to a largely defensive fighter force.

An interesting situation existed in the Luftwaffe in the second half of the war. The increasing demands for fighter pilots and the diminishing supply of fuel led to greatly reduced training for new fighter pilots before they were committed to combat. However, some of the old veterans, having flown continuously since 1939 or 1940, were probably the most skilled fighter pilots in the world. Therefore, when an allied fighter rolled in for an attack he didn't know if his intended victim was an unskilled novice which would prove to be an easy kill, or an extremely dangerous old pro with several hundred kills. This unpredictability, combined with the introduction of jet fighters, made the Luftwaffe a formidable opponent to the end.

In the following paragraphs, the Messerschmitt Bf 109 and Bf 110 are referred to by their more commonly used designations of Me 109 and Me 110. The following German aircraft types are included in Computer Air Combat:

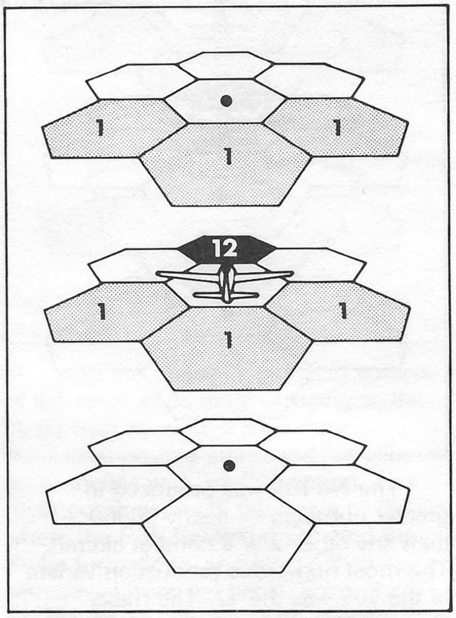
## Me 109 'EMIL'



The 'E' variant was the first mass-produced version of the Me 109, earlier versions of which saw service in Spain.

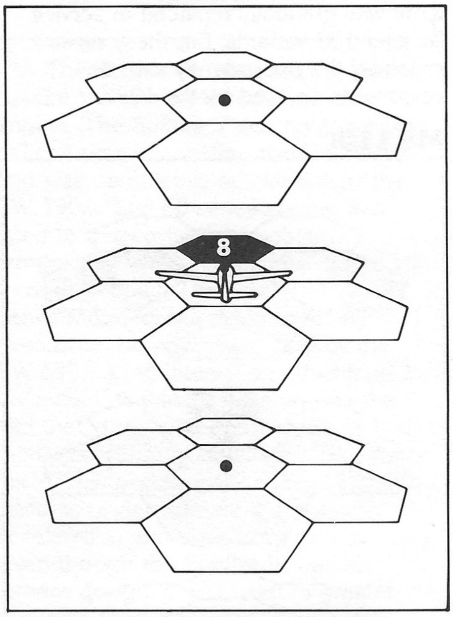
The Emil was the first-line fighter for the Luftwaffe from the start of the war through the Battle of Britain. The Me 109E was an excellent fighter, markedly superior to anything it faced except the Spitfire I. The Spitfire could out-turn the Emil, speed was essentially even, and the Emil had the superior climb rate and ceiling. The 109E was definitely the superior fighter above 20,000 ft., and could leave the Spitfire in a dive, especially since it possessed the significant advantage of not losing engine power in inverted flight — a characteristic used to great advantage by German pilots. The 109E handled well below 300 mph, but controls became progressively heavier above that speed until, around 400 mph, the ailerons in particular became almost immovable, making rolling virtually impossible. The Emil was gradually replaced in service by later 109 variants, but these never regained the ascendancy over its opponents enjoyed by the 109E.

## Me 110C



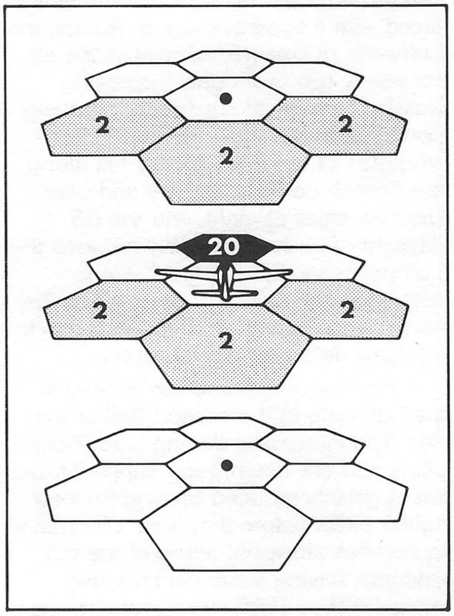
The Me 110 was designed as a long-range escort fighter, a role which could not be undertaken by its contemporary, the Me 109, which had a very short range. The 110 seemed well suited for this task when opposed by the Polish and French air forces, but was found wanting when it finally met serious opposition over England. The 110C was the variant in service from the start of the war through the Battle of Britain. Its firepower and speed seemed to make it a reasonable match for the Spitfires and Hurricanes of the RAF, but its lack of maneuverability and sluggish acceleration proved too great a handicap and often Me 109's were called upon to escort the escort fighters. After the Battle of Britain, the 110C, and other 110 variants, proved their value in roles such as bomber interception and night fighter. The 110 was a valuable aircraft as long as it didn't have to face effective single-seat fighter opposition.

## Me 109G-1 'GUSTAV'



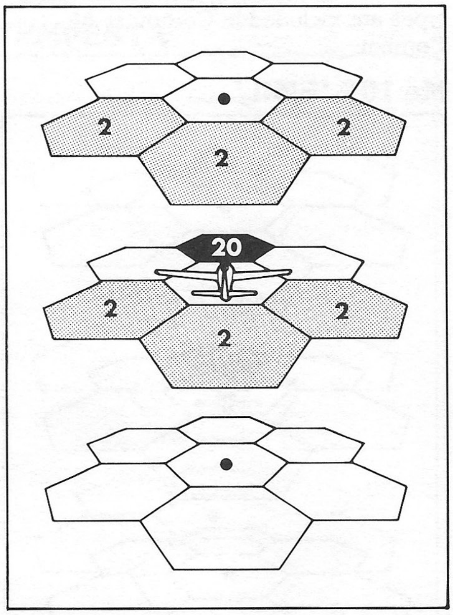
The Me 109 was produced in greater numbers — nearly 30000 — than any other WW II combat aircraft. The most numerous production variant of the 109 was the 'G'. The major change denoted by the Gustav was the installation of the more powerful DB-605 engine. Later variants of the 109G had additional armament, water-methanol injection, pressurized cabin, and other modifications. The Gustav was faster and more maneuverable than the earlier 109's, but also more difficult to fly and, especially, to land. The 109G was a common adversary for the USAAF escort fighters over Germany.

## Me 110G-4



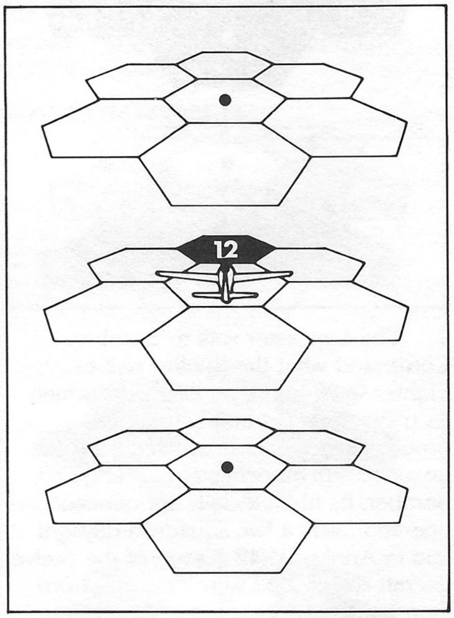
Initial production of the 110G, designed to take advantage of the DB-605 engine, were built as fighter-bombers. As the RAF night bombing offensive increased, the need for night fighters increased. The G-4 was the first 110G variant built especially for the night fighter role. It carried an extra crew member to monitor the Lichtenstein SN 2 radar. The Me 110G proved quite well suited to the night fighter role and by mid-1943, were inflicting significant damage on the British bomber offensive.

## JU 88G



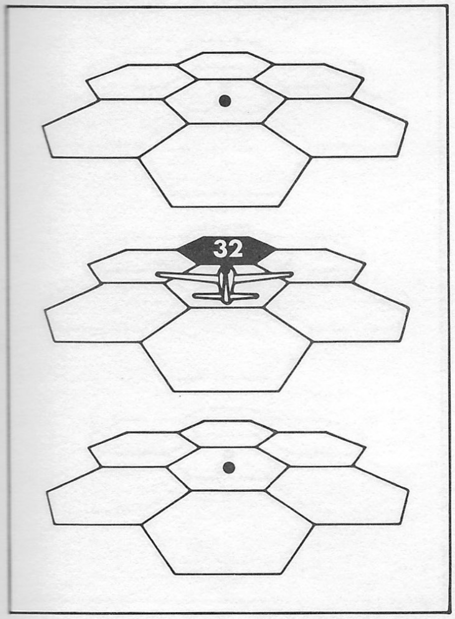
In addition to its well known role as a bomber, the JU 88 was also developed as a heavy fighter, and entered service as a night fighter in 1940. The 'G' variant appeared in mid-1944 and participated in the defensive struggle against the British night bombing campaign until the end of the war. The JU 88 was the backbone of the German night fighter arm, which reached its peak of success just prior to the introduction of the 'G'. The performance, armament and radar of the 'G' offered promise of continued success, but its introduction into service coincided with the final decline of the Luftwaffe in general and its potential was never realized.

## FW 190D 'LONG NOSE'



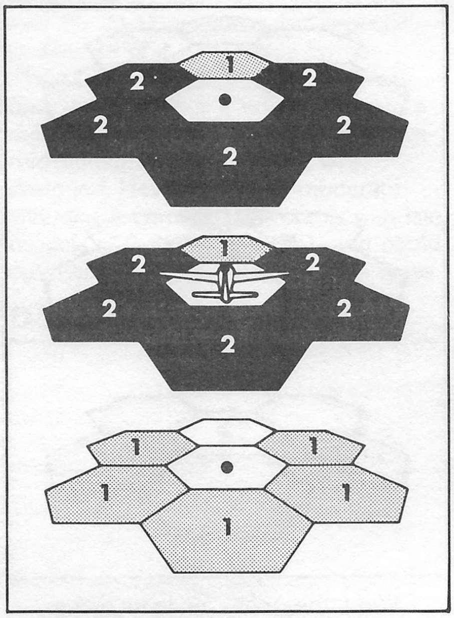
When it was first introduced in spring of 1941, the FW 190A met with startling success against the RAF, and was clearly superior at low to medium altitude to anything opposing it. Continued development of the FW 190 led to the production of the FW 190D, which entered service in early 1944. The design was surprising in that it utilized a 12 cylinder inverted-V liquid-cooled engine in place of the 14 cylinder air-cooled radial of the original design. The FW 190D proved to be an exceptionally fast and maneuverable fighter, especially at altitude. In the hands of an experienced pilot, it was more than a match for any of the allied fighters operating against it. Later developments of the FW 190D were renamed Ta 152 in honor of their designer, Kurt Tank.

## Me 262A-1 'SCHWALBE'



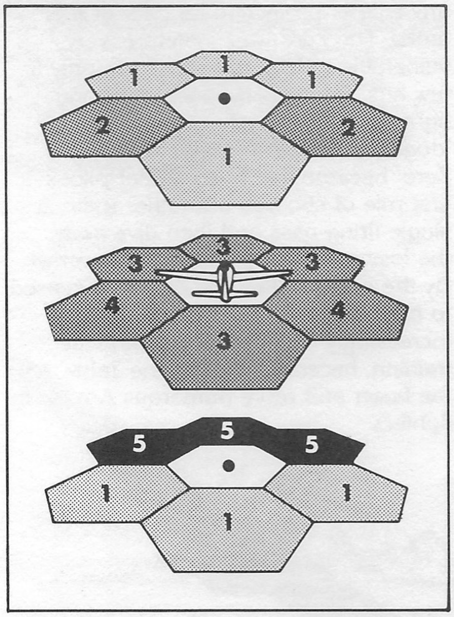
The Me 262 was the fighter which could have dramatically changed the course of the war in the air, specifically the daylight strategic bombing campaign being successfully waged over Germany by the USAAF. However, despite the fact that the first jet-powered prototype flew in July of 1942, it was not until summer of 1944 that the first 262-equipped units became operational. Thereafter, although flown by some of the best fighter pilots in the Luftwaffe with deadly effectiveness against American heavy bomber formations, they proved too few and too late. The 262-1 was a pure fighter version, whereas the 262A-2 was a fighter-bomber, a result of Hitler's incomprehensible order that the Me 262 be produced as a bomber, a role for which it was highly unsuitable. The Me 262A-1 handled beautifully at speed, but the sensitivity and slow response of the Jumo turbojets made it a difficult aircraft to fly. If high speed was maintained, the Me 262 was all but immune to the Allied fighters swarming over Germany in late 1944 and 1945, but many of them were shot down when they slowed in combat, or were in the landing circuit. The major function of the 262 was to shoot down bombers, and this it did with great success using its very heavy cannon armament, as well as racks of 5cm rockets. Normally, a head-on diving pass was made, followed by a high-speed escape above the bomber formation. It was discovered that the standard Bendix turret of the B-17G could not track the Me 262 in this maneuver.

## JU 88A



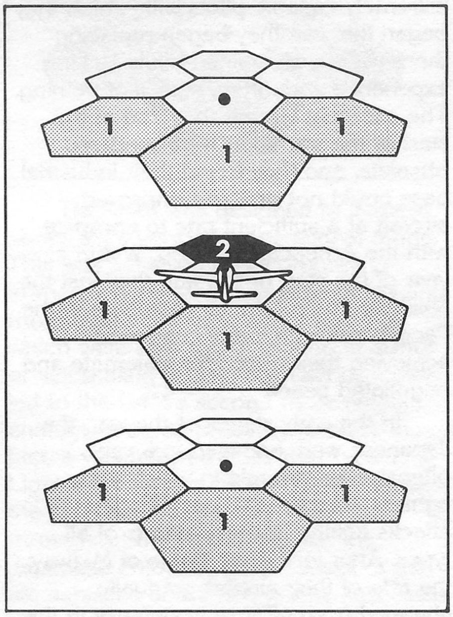
The JU 88 was produced in greater numbers than all other German bombers combined. The 'A' variant, designed as a medium bomber with the speed of a fighter, made its first operational sortie in September of 1939 and continued in that role well into 1943. The JU 88A flew in all theatres in which the Luftwaffe was engaged, as a dive bomber, a level bomber, a torpedo bomber, or a reconnaissance aircraft. Despite its wide use in all fronts, the JU 88A is probably most often remembered coming in low over the English coast to strike an RAF fighter field during the Battle of Britain.

## HE 111H-6



The HE 111H was the major medium bomber of the Luftwaffe at the start of the war and, with the JU 88, carried the brunt of the bomber offensive over England in the Battle of Britain. The HE 111 was generally popular with its crews and possessed pleasant control characteristics and excellent stability. However, the speed and defensive armament of the HE 111 proved unable to permit it to operate without escort against RAF fighters, and heavy losses were sometimes experienced. With the commencement of the night blitz on London, the HE 111H became the principal night bomber of the Luftwaffe and was a common target for RAF night fighters.

## Ju 87B 'STUKA'



With the Luftwaffe enjoying control of the air in all its early campaigns, the Ju 87 built an almost legendary reputation among friend and foe alike as an invincible and deadly weapon. This myth continued until the Battle of Britain where the RAF fighters decimated the Stuka formations, and forced their withdrawal from the battle. From then on, the Stuka operated with success in North Africa, and the Eastern front, but was rarely seen over Western Europe. The 'B' variant constituted the vast majority of the nine Ju 87-equipped Gruppen operational in September of 1939. They saw extensive service over Poland, France, and in the Battle of Britain, and continued first-line operations over Russia until late in the war. The Ju 87 was not a pleasant aircraft to fly, but was rugged and almost impossible to overstress. Some pilots, like the legendary Hans Rudel, achieved incredible successes in the type.

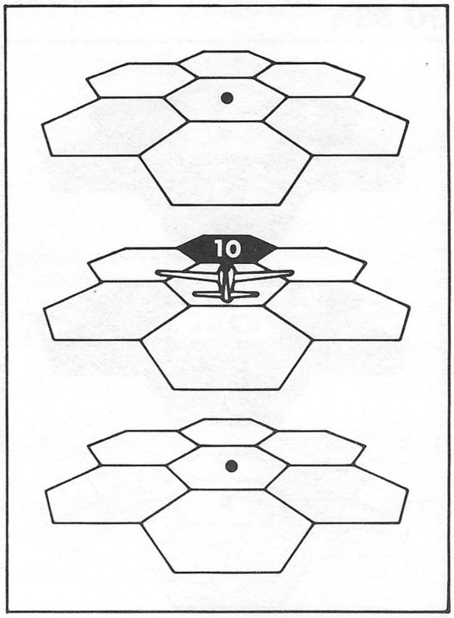
# JAPAN

Both the Japanese Army and the Japanese Navy possessed significant air forces at the outbreak of the Pacific war. Both also had acquired significant experience in China, and entered World War II with a cadre of experienced pilots and air crews. After a brilliant series of victories against American, British, and Dutch Far Eastern forces, the Japanese ruled the Eastern Indian Ocean and Western Pacific primarily through the use of air power. However, as American industrial might began developing a significant air capability in the Pacific the Japanese found their air power to be very brittle. As they lost many of the extremely capable pilots with which they began the war, they began replacing them with newly trained pilots lacking experience and, often, sufficient training. The excellent aircraft they had at the start of the war soon were rendered obsolete, and they found their industrial base could not produce improved aircraft at a sufficient rate to compete with the American build-up. Within a year of the start of the war, they lost the ability to control the air anywhere in the Pacific, and with it any chance of achieving their hoped-for stalemate and negotiated peace.

In the early stages of the war, the Japanese were engaged in a very offensive air struggle in which their fighters were used to escort bombers in attacks against military targets of all types. After losing the Battle of Midway, the role of their aircraft gradually changed from offense to defense in the Solomons and New Guinea. Finally, from late 1943 to the end of the war, Japanese air forces were on the defensive everywhere, trying to counter the growing strength of the U.S. airpower, particularly the devastating strategic bombing campaign against the Japanese homeland.

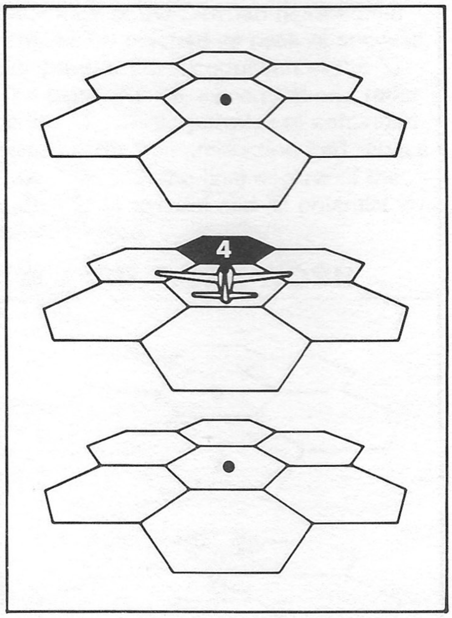
The following Japanese aircraft types are included in Computer Air Combat:

## A6M2 ZERO SEN (ZEKE)



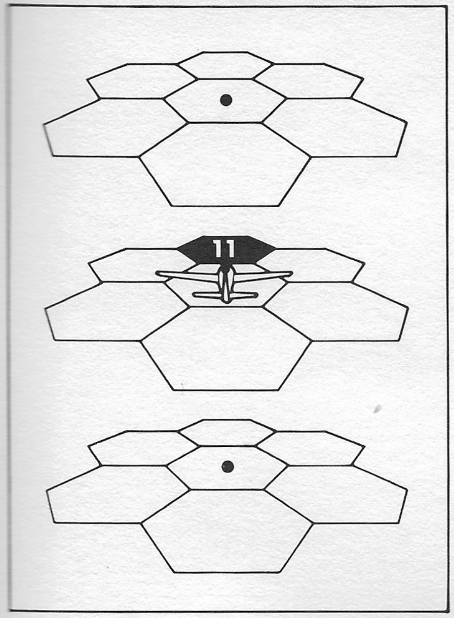
When the A6M2 made its operational debut over China in mid-1940, it was, by many standards, the best fighter in the world. It was supremely maneuverable, had an excellent climb rate, was fast, carried a heavy armament, and had a range several times that of contemporary European fighters. In the opening months of the Pacific war, the Zero reigned supreme, and, in the hands of the superbly trained Japanese Navy pilots flying it, racked up an incredible ratio of kills to losses. However, the Zero had several weaknesses which, when finally discovered, permitted it to be countered and, eventually, defeated. The A6M2 gained much of its performance and maneuverability by being very light, and it gained its lightness by forsaking any type of protection for pilot or fuel tanks. The Zero was, therefore, very vulnerable to fatal damage from only a few hits. Additionally, once opposing fighter pilots learned not to try to 'dogfight' the Zero ('Never turn with a Zero' became the Allied fighter pilot's first rule of survival) but rather make a single firing pass and then dive away, the loss ratio made a dramatic reversal. By the end of 1942, the Zero had ceased to be the Terror of the Pacific, and, increasingly flown by pilots with little training, became 'Meat on the Table' to the faster and more numerous American fighters.

## Ki. 43-IIa HAYABUSA (OSCAR)



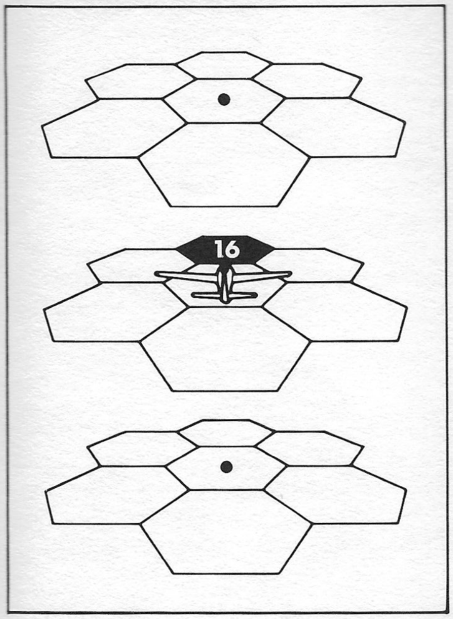
The Ki. 43 was the Japanese Army's most advanced fighter operational at the opening of the Pacific war. It was a contemporary of the JNAF Zero, and was similar in many respects. It was a very light fighter, with a low wing and power loading. It was not quite as maneuverable as the Zero, but had a higher sustained rate of climb. It also shared the Zero's total lack of armor protection. The Model II, which appeared in 1942, featured increased power, some armor protection, and an increase in firepower, from two 7.7mm nachine guns in the early model I, to two 12.7mm machine guns — still significantly below western standards of that time. The Hayabusa's turn and stall characteristics were superior to any allied fighter of its day. It could be looped and Imelmanned at an airspeed of 170 mph, and could accelerate from 150 mph to 250 mph very rapidly. However, it was slower in both level speed and dive speed than any allied fighters it faced after mid-1942, and was significantly lacking in firepower and sturdiness. Nevertheless, various versions remained in first-line service throughout the war.

## A6M5 ZERO SEN (ZEKE 52)



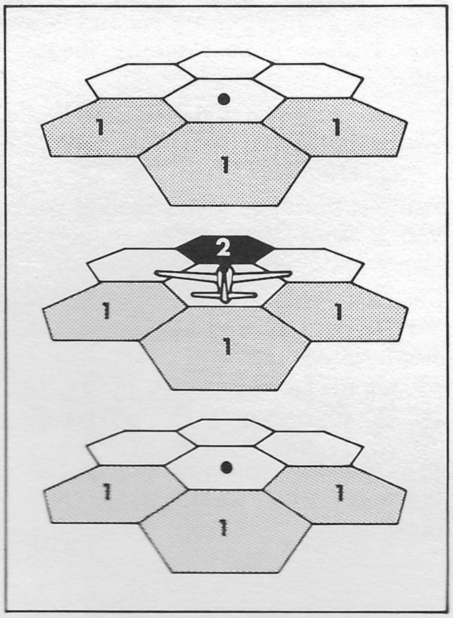
The A6M5 was an improved version of the Zero with reduced wing span, and minor engine modifications which boosted performance somewhat. The A6M5 became operational in late 1943, and was numerically the most important Japanese fighter. Despite continued minor improvements to the A6M5, it became more and more outclassed by American fighters and pilots and never enjoyed the period of brilliant success enjoyed by the earlier Zeros. The A6M5 served numerous roles, including night fighter, dive bomber, and finally suicide attack aircraft.

## Ki. 84-I HAYATE (FRANK)



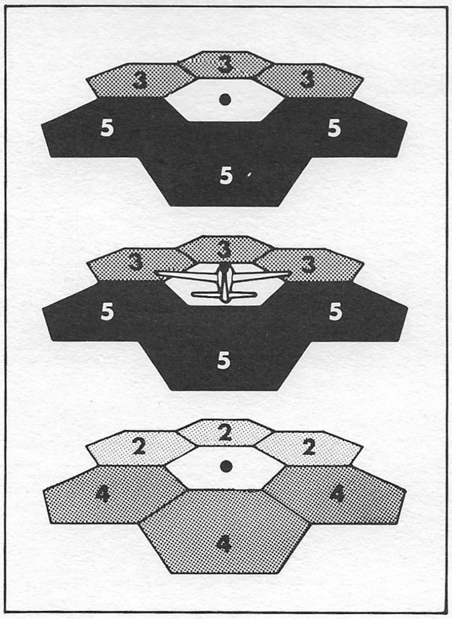
The Ki.84 was developed for the Japanese Army Air Force between 1942 and 1944, becoming operational over China in September of 1944. From then to the end of the war, the Hayate became a common adversary where ever the JAAF operated, but especially in defense of the Japanese home islands. The Hayate was at a constant disadvantage since it was forced into a defensive role rather than the offensive mid-altitude role for which it was designed. Nevertheless, at moderate altitudes, it compared favorably with late models of the P-47 and P-51, and could out-maneuver and out-climb both types.

## D3A1 TYPE 99 (VAL)

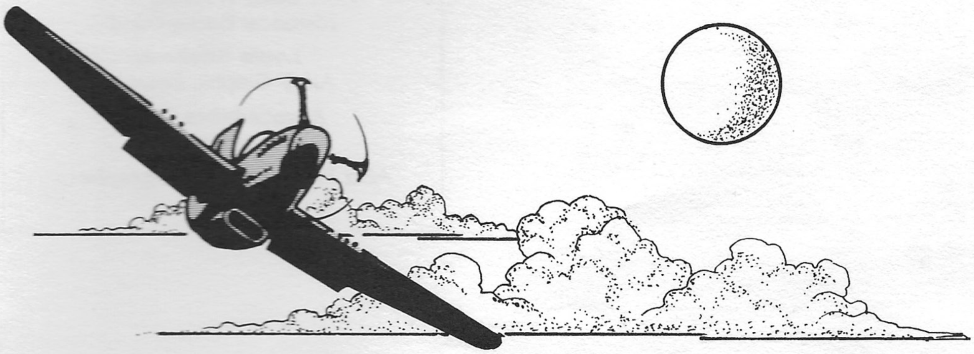


The D3A1 was the standard Japanese Naval Air Force dive bomber in service at the time of Pearl Harbor, and was instrumental in most of the Japanese naval actions involving carrier aircraft through 1943. In the hands of the well-trained pilots flying it early in the war, the D3A1 was an excellent and accurate dive bomber, and was sufficiently maneuverable and well-armed to put up a creditable fight against allied fighters then in service.

## G4M1 TYPE 1 (BETTY)



The G4M was designed to achieve, above all, a very long operational range. This was achieved by incorporating immense wing tanks, capable of holding more than 1100 Imp. gal of fuel, but which were also totally lacking in armor or self-sealing protection. This ultimately led to the G4M's second most notable characteristic, its proclivity to burn. In fact, it was referred to as the 'Type 1 Lighter' by its own crews. Nevertheless, the G4M served with the JNAF throughout the war, and when the Japanese enjoyed virtual control of the air, achieved some noteworthy successes including the sinking of the Repulse and Prince of Wales. As control of the air slipped from the Japanese, the fortunes of the G4M fell, all too often in flames. In its decline, the G4M continued to be a significant, if not totally successful aircraft, and again gained notoriety as the aircraft in which Japanese Admiral Yamamoto was shot down by intercepting P-38's. At the very end, it was also the aircraft which, stripped of armament and painted with 'surrender crosses', carried the Japanese surrender delegation to Ie Shima.



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